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Original Article

Developing a Basic Scale for Workers' Psychological Burden from the Perspective of Occupational Safety and Health

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ABSTRACT

Background: Organizations are pursuing complex and diverse aims to generate higher profits. Many workers experience high work intensity such as workload and work pressure in this organizational environment. Especially, psychological burden is a commonly used term in workplace of Republic of Korea. This study focused on defining the psychological burden from the perspective of occupational safety and health and tried to develop a scale for psychological burden.

Methods: The 48 preliminary questionnaire items for psychological burden were prepared by a focus group interview with 16 workers through the Copenhagen Psychosocial Questionnaire II and Mindful Awareness Attention Scale. The preliminary items were surveyed with 572 workers, and exploratory factor analysis, confirmatory factor analysis, and correlation analysis were conducted for a new scale.

Results: As a result of the exploratory factor analysis, five factors were extracted: organizational activity, human error, safety and health workload, work attitude, and negative self-management. These factors had significant correlations and reliability, and the stability of the model for validity was confirmed using confirmatory factor analysis.

Conclusion: The developed scale for psychological burden can measure workers' psychological burden in relation to safety and health. Despite some limitations, this study has applicability in the workplace, given the relatively small-sized questionnaire.

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1. Introduction

Organizations today are pursuing complex and diverse aims to generate higher profits. They must constantly change to achieve these ends—namely, by organizing and managing products, work methods, technological innovations, human resource policies, forms of work organization, and so on. Such organizational changes lead to greater work intensity. The increased workload has negative effects on workers' health and safety, including musculoskeletal disorders, psychological distress, fatigue, and accidents, and is a

factor that increases absenteeism, presenteeism, staff turnover, and poor quality of work within an organization [1].

The factors giving rise to workers' psychological burdens, described in various terms such as workload, work strain, and work pressure, are also known to impede the implementation of safety behaviors by depleting the resources needed for their implementation [2,3]. Volkoff et al [4] reported that the pressure resulting from work pace affected the health of workers in their 50s and above. Cantin et al [5] found that when driving work became complicated and the workload was high, drivers faced high mental

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load, resulting in poorer work performance including slower reaction times with older drivers exhibiting a greater drop in performance than younger drivers as their workload increased.

Organizations are looking for effective ways to evaluate workload, but many assessment tools are designed to measure only essential features such as mental workload and, thus, provide a divided understanding of the workplace. Moreover, there is a need for a broad approach that goes beyond the traditional concept of workload, distinguishes between physical and mental components, and can encompass the complexity of work activities in diverse environments [1]. According to Zhang and Luximon [6], workload is affected by various psychological, physical, and environmental factors and consists of mental demand, physical demand, temporal demand, performance, effort, and frustration. Workload can also refer to the amount of work that an individual has to perform, but there is a difference between the actual amount of work and the amount of work perceived by the individual. In other words, even if the amount of work is the same, the perceived workload differs among individuals, and the workload may be analyzed into quantitative load (time and amount of work) and qualitative load (difficulty level) [7].

Workload is also treated as one of the stress factors in job stress models; work overload, work complexity, work underload that does not match the worker's level, and other factors are considered to be causes of job stress [8]. The Korean Occupational Stress Scale also treats job demand as one of its subscales, including items such as time pressure, work interruption, increased workload, responsibility, excessive burden, work-home balance, and multitasking [9]. Previous research has traditionally approached the subject matter from a perspective that distinguishes between physical and mental workloads [10]. Physical workload was approached from an angle that deals with the limitations of physical work performance that could affect the health and safety of workers [11,12]. In experimental psychology, mental workload was approached from an angle that identifies cognitive or mental limitations affecting human performance in information processing [13]. Responsibility, uncertainty, time pressure, job interruption, and other factors were added to the physical and mental workload factors, and these factors again serve to increase physical and mental workloads [1]. Physical scales focused on activities responding to stress by assessing criteria such as heart rate and blood pressure. Subjective scales, on the other hand, which provided relatively immediate data based on the assessment of perceived workloads to workers, are considered to be convenient and less expensive and, thus, are found to have higher validity than physical scales [14]. Hart and Staveland [15] noted that such subjective scales are among the most common methods of assessing workloads. Representative scales include the National Aeronautics and Space Administration Task Load Index [14,15], the Subjective Workload Assessment Technique [16], the Workload Profile [16], the Borg CR10 Scale [17], and the Multivariate Workload Index [18].

Psychological burdens such as workload not only impede work performance but also can have a direct impact on the safety of workers through accidents and so forth. Despite this, however, there have not been many attempts to develop an assessment tool for measuring the psychological burdens related to the occupational safety and health of workers. In particular, although "psychological burden" is a commonly used term in the workplace in Republic of Korea, it does not have much currency in the academic field relative to other terms such as workload. Job stress and workload can be interrelated, and there is also a corresponding conceptual overlap between them [19]. However, the present study defines "psychological burden" using a more fine-grained concept than job stress and attempts to develop a scale that can measure it.

According to the Cambridge Dictionary [20], "burden" is defined as "a heavy load that you carry" or "something difficult or unpleasant that you have to deal with or worry about." Because the aim of this study is to develop a scale for psychological burdens affecting occupational safety and health through work accidents and so on, psychological burdens here may be regarded as burdens pertaining to the work directly performed by workers or to other related work. More specifically, excessive work amount, work pace, safety and health conditions related to work, and so on can be deemed determinants of psychological burden. Thus, the present study defines the psychological burden of workers in terms of emotions such as concern, anxiety, uneasiness, and depression felt by workers due to their concerns about the success or failure of their work and their safety, which are affected mainly by the workload and work conditions. This conceptual definition serves as the point of departure for our study.

To develop our psychological burden scale, we reviewed the Copenhagen Psychosocial Questionnaire II (COPSOQ II) [21]—developed by the National Institute of Occupational Health in Denmark to assess the health effects of the psychosocial environment of workers in diverse occupations—and the Korean version of the Mindful Awareness Attention Scale (K-MAAS) [22]. Using these scales as the basis, we revised the questionnaire items to suit our research aims through a focus group interview (FGI) and composed preliminary questionnaire items. The COPSOQ II can be used to carry out a comprehensive assessment of the psychosocial work environment. Therefore, it has recently been widely used in Asian countries, and in Republic of Korea, June and Choi [23] conducted a study on its validity. In particular, the COPSOQ II deals with workload-related questions and psychosocial questions in various industrial fields, including job demands, organizational structure, work-individual interface, health and well-being, and offensive behaviors mentioned in the previous studies. As previously mentioned by Fournier [1], it was judged to be suitable as a basic tool.

In addition, as Kim and Ahn [24] mentioned in their previous study, the ability of workers to concentrate in given work situations is one of the important factors for the prevention of safety accidents. One of the concepts associated with consciousness and attention is the concept of mindfulness. Ludwig and Kabat-Zinn [25] emphasized mindfulness as a critical way to pay attention to what is happening now and turned out that mindfulness training has been shown to help emotional stability and has a positive effect on stress reduction and psychological well-being. And recently, the mindfulness concept helps workers to perform effective actions that are appropriate to their situation in the workplace. Because this can lead to the prevention of work accidents [26], we used the K-MAAS along with the COPSOQ II to prepare preliminary questionnaires to use in the present study. In addition to the exploratory study for the development of the scale, the confirmatory factor analysis tried to confirm the validity of the developed scale.

2. Materials and methods

2.1. Measurement

The version of the COPSOQ II designed for professional use consists of a total of 127 questionnaire items with subscales pertaining to "demands at work," "work organization and job contents," "interpersonal relations and leadership," "work-individual interface," "health and well-being," and "offensive behavior" [21]. The Mindful Attention Awareness Scale (MAAS), as developed by Brown and Ryan [27], is a representative questionnaire for assessing mindfulness, and the version used in Republic of Korea is the K-

Table 1
Characteristics of participants.

Characteristics		Frequency	Percentage (%)
Gender	Male	491	85.8
	Female	79	13.8
	Nonresponse	2	0.3
Marriage	Married	151	26.4
	Unmarried	414	72.4
	Nonresponse	7	1.2
Age	10s	1	0.2
	20s	80	14.0
	30s	156	27.3
	40s	160	28.0
	50s	157	27.4
	60s	16	2.8
	Nonresponse	2	0.3
Industry	Manufacturing industry	340	59.4
	Service industry	172	30.1
	Construction industry	13	2.3
	Others	47	8.2
Position 1	Office worker	142	24.8
	Field worker	406	71.0
	Others	24	4.2
	Nonresponse	0	0.0
Position 2	Manager	165	28.8
	Regular worker	386	67.5
	Others	18	3.1
	Nonresponse	3	0.5
Working time per day	Less than 8 hours	108	18.9
	8–10 hours	397	69.4
	10–12 hours	54	9.4
	More than 12 hours	8	1.4
	Nonresponse	5	0.9
Average of holiday work per month	0 day	115	20.1
	1–3 days	229	40.0
	3–6 days	161	28.1
	More than 7 days	56	9.8
	Nonresponse	11	1.9

MAAS, a literal translation of the MAAS consisting of 15 questions [22].

2.2. Participants and study design

To develop the psychological burden scale, we conducted an FGI with workers ($n = 16$) involved in industrial accidents who were receiving medical care in hospitals during the months of June and July of 2016. Based on the result of an FGI, 48 preliminary questionnaire items were prepared for the psychological burden scale after a review by the research team comprising specialists in the fields of psychology, human engineering, business administration, and statistics. The present survey was conducted with 572 workers in August 2016. The 572 workers were mainly engaged in manufacturing, construction, and service industries, which are the representative industries of Republic of Korea. They belong to workplaces that expressed their willingness to participate in this study voluntarily according to the promotion of the survey. At each workplace, the questionnaire forms were distributed to workers who are selected randomly according to their workplace schedules, and the completed forms were sent to the researchers by mail. Workers who participated in this study were informed that all surveys were used for only research purposes and that the results of individual responses were not provided or used by the companies or employers.

2.3. Statistical analysis

Among the 572 workers who participated in the present survey, we excluded 16 who did not answer questions related to psychological burden among the preliminary questionnaire items and

analyzed the data of the remaining 556 participants. We used SPSS 23.0 version by IBM to conduct an exploratory factor analysis and to analyze correlations and reliability among the questionnaire items. In addition, we conducted a confirmatory factor analysis for confirming the validity of the developed scale by AMOS 23.0 version by IBM.

3. Results

3.1. Demographic characteristics

Among the 572 workers who participated in the present survey, 85.8% were male, and 13.8% were female; 72.4% were married, and 26.4% were unmarried. Broken down by age group, those in their 40s were the largest group (28.1%), and those in their 50s (27.5%) and 30s (27.4%) were similar in size; these three age groups constituted 83.0% of the total number. Broken down by industry and occupation, 59.4% were in the manufacturing industry, and 30.1% were in the service industry; 67.5% were regular workers in nonmanagerial positions, and 28.8% managers; and 71.0% were field workers, and 24.8% were office workers. Working time per day and average of holiday work per month were also analyzed. Table 1 presents the demographic characteristics.

3.2. The FGI and preliminary questionnaire items

The structured questionnaires for the FGI used COPSOQ II and MAAS. The contents of the questionnaires were reviewed in advance with the supervisor working in the general enterprise to confirm whether the level of questionnaires is proper to the level of participants before the FGI. At the time of the industrial accident, the participants comprised three (18.75%) managers, 10 (62.5%) general workers, and three (18.75%) other workers. As a result of the FGI, participants responded to the uncomfortable feelings on the accident day, the state of mind or the work of that day, and the uncomfortable minds and hard things from the accident day to last week before the FGI.

In the process, there were some opinions that the vocabulary was difficult or understood in the same context, or some defensive items (e.g., “Is safety a priority among employees?” or “Are senior employees doing work with safety as a top priority?”). There was also a response that it was impossible to clearly distinguish between “mental” and “emotional,” and the stiff words such as “regulation” and the incomprehensible word such as “consciousness” were modified. In particular, the items related to mindfulness were considered to be used to examine contents related to safety accidents because they deal with contents such as attention and memory. However, in the FGI process, workers responded that mindfulness items were difficult to understand so that these items were excluded in the final preliminary questionnaire composition. As a result of the FGI and the researchers’ review, preliminary questionnaires were finally composed of 48 items. The preliminary questionnaires are shown in Table 2.

3.3. Exploratory factor analysis

In developing the scale for measuring psychological burdens, we conducted the exploratory factor analysis using principal axis factoring along with varimax rotation for subitems in each domain. The criterion used for factor selection was having a Kaiser–Meyer–Olkin value and eigenvalue of 1.00 and above. Moreover, correlation coefficients among the items were used to improve internal reliability by eliminating highly correlated items and to yield the Cronbach α value indicating internal consistency among the items. As a result of the factor analysis, five factors with an eigenvalue of

Table 2
Preliminary questionnaire items for psychological burden.

Item number	Item content
Q1	Did you feel the work-related psychological burden that you have done over the past 1 week?
Q2	Did you have a lot of work to do over the past 1 week?
Q3	Are there times when the colleagues at your workplace work too hard?
Q4	Did you have to deal with your task quickly over the past 1 week?
Q5	The work I do is very important.
Q6	Did you do your work what is familiar to you over the past 1 week?
Q7	Did you do a work which has a lot of physical burden over the past 1 week?
Q8	Did you do a work which has a lot of psychological burden over the past 1 week?
Q9	Is the physical environment at your workplace bad (noise, lighting, heat, dust, etc.)?
Q10	Can accidents occur in the work you have been doing over the past 1 week?
Q11	Are the safety features on the machinery, etc., you have been operating over the past 1 week inadequate?
Q12	Did you receive adequate safety training in relation to the work you have been doing over the past 1 week?
Q13	In some cases, you may not be able to follow the standard procedure.
Q14	Are you worrying about the job security?
Q15	Is your job motivated enough?
Q16	Are you receiving fair treatment from your organization?
Q17	Do you maintain good relationships with your superiors?
Q18	Are you satisfied with your current job?
Q19	Have you experienced conflicts like bullying or quarrels at your workplace over the past 1 week?
Q20	Do you lack free time in your personal life due to work?
Q21	Does it work well with colleagues who work with you or other company's employees who need to cooperate with you?
Q22	Does your company share key information with employees?
Q23	Are you well informed about the precautions you have to take during the work process?
Q24	Do you tell your opinions to your superiors when there is a problem?
Q25	Did you take enough sleep over the past 1 week?
Q26	Did you feel physical fatigue over the past 1 week?
Q27	Are you financially compensated enough for your work?
Q28	Did you think you lack confidence over the past 1 week?
Q29	Did you experience any bodily pain or discomfort over the past 1 week?
Q30	Have you ever felt that your memory has worsened over the past 1 week?
Q31	Have you ever been threatened by violence at work for a year?
Q32	I am usually good at managing my self-esteem.
Q33	There was a time to make mistakes because I did not pay attention.
Q34	When interacting with others, I tend to put myself in their shoes.
Q35	It is easy for you to hide your intention or real mind.
Q36	I cannot concentrate on what I am doing, and I tend to work automatically sometimes.
Q37	I tend to do well or poorly at work depending on my mood on particular days.
Q38	Is your work something that anyone can do easily with a little training?
Q39	Do you often worry about the future?
Q40	Are you familiar with your current work?
Q41	Do you often take a break to recharge?
Q42	Are the facilities on the work site complicated?
Q43	Were there occasions at work when you almost made a mistake?
Q44	Have you ever felt that it would be nice to beef up the safety equipment in your everyday work?
Q45	Are the passageways and the workspace at your workplace cluttered?
Q46	I have colleagues who seem to be working hard and constantly.
Q47	Would your work be delayed if safety were emphasized?
Q48	I am not good at self-assertion, so I tend to drown my complaints in alcohol.

more than 1.00 were extracted, and the final questionnaire items falling under each factor are shown in Table 3 with factor loading value.

The first factor is given the label "organizational activity." Organizational activity can be defined as a variety of activities within the organization. As mentioned in Rutherford's previous study [28], it is considered to be a supporting factor that

organizational and professional culture can affect workload. It includes items derived mostly from the COPSOQ II, pertaining to relationship with superiors, fair treatment, the company's information disclosure policy, and so on.

The second factor is labeled "human error." The definition of human error can be found in many previous studies. However, in this study, errors such as mistakes are caused in the workplace

Table 3
The results of explorative factor analysis.

Item number	Item content	Factors				
		Organizational activity	Human error	Safety and health workload	Work attitude	Self-management
Q18	Are you satisfied with your current job?	0.712	0.023	0.137	0.011	0.114
Q17	Do you maintain good relationships with your superiors?	0.669	0.101	0.270	-0.045	0.058
Q23	Are you well informed about the precautions you have to take during the work process?	0.585	0.061	-0.016	0.240	-0.046
Q19	Have you experienced conflicts like bullying or quarrels at your workplace over the past 1 week?(R)	-0.574	-0.077	-0.281	-0.170	-0.188
Q16	Are you receiving fair treatment from your organization?	0.513	0.061	0.131	0.260	0.035
Q22	Does your company share key information with employees?	0.483	0.114	0.075	0.254	0.136
Q24	Do you tell your opinions to your superiors when there is a problem?	0.447	-0.084	-0.044	0.332	0.186
Q10	Can accidents occur in the work you have been doing over the past 1 week?	0.018	0.584	0.134	0.066	0.081
Q43	Were there occasions at work when you almost made a mistake?	0.054	0.567	0.013	-0.086	-0.048
Q46	I have colleagues who seem to be working hard and constantly.	0.197	0.567	0.237	0.056	0.096
Q48	I am not good at self-assertion, so I tend to drown my complaints in alcohol.	0.119	0.564	0.172	0.082	-0.087
Q11	Are the safety features on the machinery, etc., you have been operating over the past 1 week inadequate?	-0.070	0.553	0.176	0.088	0.175
Q47	Would your work be delayed if safety were emphasized?	0.151	0.531	0.275	0.179	0.027
Q44	Have you ever felt that it would be nice to beef up the safety equipment in your everyday work?	0.004	0.506	0.047	0.261	0.086
Q45	Are the passageways and the workspace at your workplace cluttered?	-0.009	0.435	0.004	-0.003	0.091
Q9	Is the physical environment at your workplace bad (noise, lighting, heat, dust, etc.)?	0.145	0.200	0.724	0.117	0.039
Q3	Are there times when the colleagues at your workplace work too hard?	0.144	0.210	0.724	0.087	0.036
Q2	Did you have a lot of work to do over the past 1 week?	0.184	0.125	0.687	0.264	0.133
Q5	The work I do is very important.	0.114	0.206	0.600	0.092	0.052
Q34	When interacting with others, I tend to put myself in their shoes.(R)	-0.124	-0.158	-0.010	-0.605	-0.157
Q37	I tend to do well or poorly at work depending on my mood on particular days.	0.263	0.085	0.271	0.574	0.077
Q29	Did you experience any bodily pain or discomfort over the past 1 week?	0.203	0.088	0.163	0.508	0.097
Q38	Is your work something that anyone can do easily with a little training?	0.180	0.044	0.246	0.485	0.164
Q32	I am usually good at managing my self-esteem.(R)	-0.079	0.024	-0.030	-0.167	-0.809
Q20	Do you lack free time in your personal life due to work?	0.190	0.116	0.137	0.102	0.562
Q12	Did you receive adequate safety training in relation to the work you have been doing over the past 1 week?(R)	-0.108	-0.259	-0.045	-0.177	-0.522
	Eigenvalue	2.707	2.643	2.471	1.181	1.513
	Variance (%)	10.410	10.167	9.505	6.993	5.819
	Cumulative variance (%)	10.410	20.576	30.082	37.075	42.894
	Reliability	0.821	0.785	0.829	0.725	0.705

(R), reversed question.

because of psychological burden, and these errors might lead to safety accidents again. So, it can be defined as a human error related with psychological burden and occupational accidents. It includes items related to human error such as work accident experience, work risk, safety devices, and so on.

The third factor is labeled “safety and health workload.” Safety and health workloads can be defined as burdens for work related to safety and health, which include both work environment and physical and psychological workload. It is similar to previous studies on workloads such as those by Volkoff et al [4], Pickup et al [29]. It includes work amount, importance of the work, workload, and so on.

The fourth factor is labeled “work attitude.” Work attitudes can be defined as the attitudes of workers toward their jobs that can affect psychological burdens. It is similar to the previous study by Houdmont and Leka [19], which noted that individual differences such as the worker's abilities, emotions, etc. might affect the work. It includes items related to putting oneself in another's shoes, individual workers' work attitudes that depend on their mental or physical condition, and so on.

The fifth factor is labeled “negative self-management.” In a previous study by Burgess et al [30], it was mentioned that individual differences such as sincerity could be affected due to workloads. So, negative self-management can be defined as a negative

area of workers' personal management that might be affected because of human error. It includes several personal management items such as self-esteem and free time that can contribute to psychological burden or human error.

3.4. Analysis of reliability and correlations among the factors

To analyze the internal validity of the scale, the interitem reliability analysis of factors and the correlation analysis between factors were conducted. The mean value (standard deviation) and the Cronbach α value within each factor are shown in Table 4. All items of factors showed a reliability of 0.65 – 0.83 in Cronbach α value, and the

Table 4
The mean value (standard deviation) and the Cronbach α value of each factor.

Factors	The number of items	Mean (SD)	Cronbach α
Organizational activity	7	16.81 (3.39)	.81
Human error	8	22.88 (4.71)	.79
Safety and health workload	4	11.47 (2.97)	.83
Work attitude	4	9.74 (2.41)	.72
Negative self-management	3	5.74 (1.82)	.65

Table 5

The results of a correlation analysis with factors.

	Safety and health workload	Work attitude	Organizational activity	Negative self-management	Human error
Work attitude	0.346***	—			
Organizational activity	0.467***	0.321***	—		
Negative self-management	0.397***	0.240***	0.388***	—	
Human error	0.292***	0.264***	0.222***	0.414***	—

*** $p < 0.001$.

results of correlation analysis between factors are given in Table 5. All the factors were found to have statistically significant correlations.

3.5. Confirmatory factor analysis

For the internal validation of the model, a confirmatory factor analysis was performed on the five factors obtained via the exploratory factor analysis and the questionnaire items related to these factors. We tested the stability of the model using various indices such as χ^2/df , Root Mean Square Error of Approximation (RMSEA), Goodness of Fit Index (GFI), Normed Fit Index (NFI), Comparative Fit Index (CFI), and the confirmatory factor analysis model, and results are shown in Fig. 1. The various indices showing how well the model fits the data are provided in Table 6.

It was found that $\chi^2/df = 2.0792$ ($p = 0.00$), RMSEA = 0.044, GFI = 0.930, NFI = 0.921, and CFI = 0.934. Usually, if the χ^2/df value is less than 3, it indicates a good fit. GFI, Tucker-Lewis Index, and CFI values are acceptable if they exceed 0.70 and indicate a good fit if they approach 0.90. As for RMSEA, it must be less than 0.05. To make a comprehensive assessment in light of these indices, we may deem the model to be a good fit for the data. The latent variables in the model measure the same constructual concept, and, therefore, the correlations among them should not be too high ($r > 0.85$). The correlations among latent variables in our model ranged from 0.283 to 0.629. These values do not exceed 0.85, and this shows that the latent variables are not highly correlated enough to treat them mathematically as the same factor.

4. Discussion

The present study is an attempt to develop a scale for measuring the psychological burdens that impact occupational safety and health. The results of study can be summarized as follows.

First, we provided a conceptual definition of workers' psychological burden that differentiated it from extant concepts of job stress and mental and physical workloads; prepared preliminary questionnaire items based on the COPSOQ II, MAAS, and an FGI; and conducted the present survey using the final set of 48 preliminary items. An exploratory factor analysis revealed five factors, namely organizational activity, human error, safety and health workload, work attitude, and negative self-management. The resulting scale for psychological burdens comprised 26 items. Second, the reliability and correlation analysis of the five factors in the psychological burden scale showed statistically significant results, and a confirmatory factor analysis verified the stability of our model.

The scale items arrived at by the present study are different from the workload components mentioned in previous studies such as those of Zhang and Luximon [6] and reflect the conceptual definition of psychological burden given in the Introduction section of this article. In particular, the scale consists of those subfactors that allow us to assess the psychological burden felt by workers, the

resultant factor of human error that show up in occupational safety and health, and other factors that can influence this cause—effect relationship—namely, organizational activity, work attitude, and negative self-management. Therefore, the scale enables the joint measurement of psychological burdens that impede safe behavior and resulting human errors that occur in the domain of safety and health, as noted in the studies by Lee [2] and Jung et al [3].

This is an aspect of the scale that sets it apart from extant scales that only measure workload from the traditional perspective, such as National Aeronautics and Space Administration Task Load Index [14,15], Subjective Workload Assessment Technique [16], the Workload Profile [16], the Borg CR10 Scale [17], and the Multivariate Workload Index [18]. Previously, a validation study on the COPSOQ II [23] was conducted in Republic of Korea. However, the significance of the present study lies, on the one hand, in its revision of questionnaire items derived from the COPSOQ II through an FGI and the development of a scale that can measure workers' psychological burdens in relation to safety and health in the workplace, and, on the other hand, in its ease of applicability on the field given the relatively small size of the questionnaire in its finalized form consisting of 26 items.

Nevertheless, this study has the following limitations. First, we could not examine the relationship between the psychological burden scale developed here and other similar scales developed in previous studies. Namely, there are the job demand subscale in the Korean Occupational Stress Scale provided by Jang et al [9] and the various workload scales mentioned in the study by Hart and Staveland [15]. It seems necessary to conduct a criterion validation study to check the reliability of the scale developed here in relation to the other scales just mentioned. It is also necessary to examine how the psychological burden scale is related to other subscales of job stress, to the stress responsiveness scale, and so on to determine the effects of these factors on the psychological health of workers. In this respect, this study can be regarded as an initial step to develop the psychological burden scale, and although internal validation of the model was verified through the confirmatory factor analysis, further studies are needed to examine the more detailed relation of the developed scale with other scales using the confirmatory factor analysis in the perspective of occupational safety and health.

Second, based on previous research, mindfulness and attention were expected to be among the factors required for the prevention of work accidents, and items relevant to these factors were prepared. Most of these items, however, did not make it to the final set of factors in the scale. These items showed some problems even at the stage of the FGI as many workers had difficulty in understanding the questions related to mindfulness and probably also because the content of the items was not pertinent to the area of occupational safety and health. As noted in the study by Park [26], mindfulness training has the effect of calming the mind and improving one's attentiveness; so, there is adequate reason to expect that it can be used as a method for preventing work accidents. However, such training probably needs to be preceded by the development of appropriate measurement tools that can be understood by workers, and it is necessary to conduct it as part of future studies in the field of occupational health psychology.

Third, subscales such as organizational activity and work attitude in the psychological burden scale developed here do not represent new factors that are entirely distinct from the subscale factors of occupational stress. As mentioned in the study by Houdmont and Leka [19], factors such as workload and psychological burden are bound to be related to job stress factors. Nonetheless, there is much empirical evidence to indicate that workload and other such factors do not completely overlap with job stress factors [31]. In view of these contrasting points, there is a need to

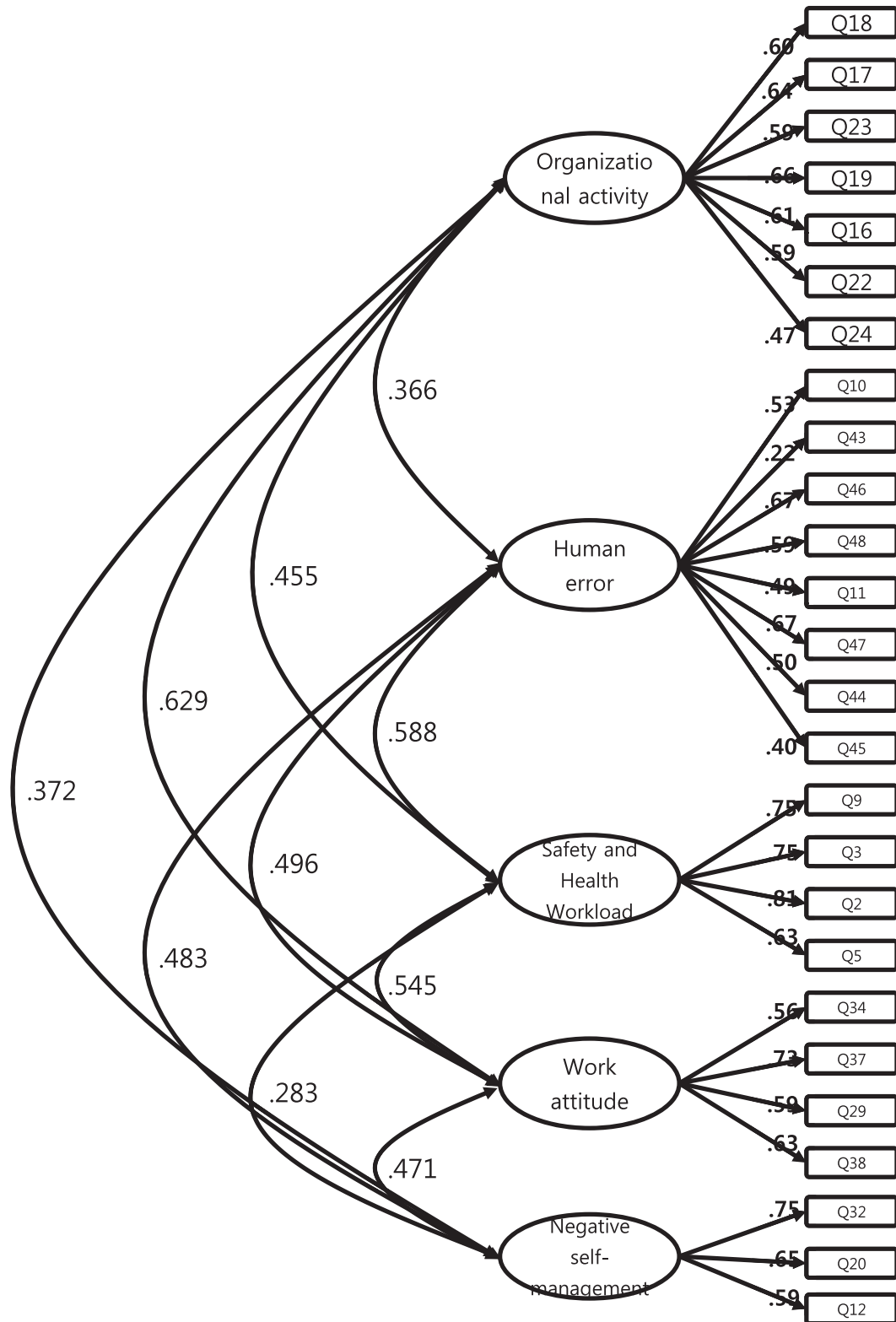


Fig. 1. The results of confirmatory factor analysis.

conduct further study on the relationship between the scale developed here and extant job stress scales, as mentioned previously in our discussion of the first limitation. In addition, although the concept of psychological burden was defined in this study, it still has some controversy such as the difference between workload

and psychological burden so that further study is needed to explain the definition of psychological burden based on evidence.

Forth, there are five subfactors in the results of the factor analysis, but some of the items are ambiguous as one factor. For example, item 12 of the negative self-management factor asks

Table 6

The various indices showing the stability of the model.

df	χ^2/df	<i>p</i>	RMSEA	GFI	TLI	CFI
272	2.079	<i>p</i> < 0.00	0.044	0.930	0.921	0.934

CFI, Comparative Fit Index; df, degree of freedom; GFI, Goodness of Fit Index; RMSEA, Root Mean Square Error of Approximation; TLI, Tucker-Lewis Index.

whether the safety education is sufficient. In the case of safety education, the employee's own will is important, but the organizational management aspect of the company also affects it. In a future study, confirming validation of the psychological burden scale repeatedly needs to be conducted through content validity review of these questions.

Finally, it is also a limitation of this study to be unable to control various workplace variables such as gender, age, industry, etc. The lack of consideration of these factors is a limitation of clear research, but it is also a difficulty of field study. Further study is needed to test the effect of these factors on psychological burden.

Despite these limitations, it is worth noting that the present study provides a conceptual definition of "psychological burden"—a commonly used term in the Korean workplace—from the perspective of occupational safety and health and presents a scale that can measure both causal factors such as psychological burden and factors such as human error that show up as results in occupational safety and health. Therefore, it is hoped that the scale developed here can serve as a means to measure and manage the psychological burden of workers.

Conflicts of interest

All authors have no conflicts of interest to declare.

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